EPA 2020 COVID-19 WATER SECTOR SURVEY

Summary Report

June 2021

EPA

810-R-21-001

KEY FINDINGS

EPA conducted a survey from October to December 2020 to learn how the COVID-19 pandemic has affected the nation's water sector (drinking water and wastewater systems), and whether the sector anticipates lasting challenges resulting from the pandemic. A statistically representative sample of 1,956 community water systems (CWSs), wastewater treatment facilities (WWTFs), American Indian utilities (AI utilities), and Alaska Native Village utilities (ANV utilities) (collectively, "utilities") responded to the survey.

Survey results indicate that:

- About one-third (36%) of the nation's water and wastewater utilities encountered **shortages or supply chain disruptions** of one kind or another in 2020. Shortages of personal protective equipment (PPE) were particularly notable, especially during the early phase of the pandemic. There were fewer shortages and supply chain disruptions involving treatment chemicals or durable goods such as valves and pipes, but chemical shortages did affect AI and ANV utilities and concerns remain about potential future disruptions throughout the sector. Concerns about future availability were most commonly expressed for sodium hypochlorite (6%), gaseous chlorine (3%), and polymers (3%).

- About one-quarter (27%) of the nation's water and wastewater utilities experienced **personnel shortages** during the pandemic, due to missed work (for example, on account of illness, care of family members, daycare closure, and virtual schooling) and other factors, such as lack of backup certified personnel. A commonly reported concern was maintaining operations should key staff become sick or be required to quarantine simultaneously. Respondents also commented that the pandemic has exacerbated existing challenges associated with an aging workforce.

- **Financial** effects of the pandemic on operating budgets were highly variable. Some utilities had shortfalls in their budget, and others had surpluses. Approximately 48% of utilities took some action to mitigate potential decreases in cash flow. Around one-quarter (24%) of utilities drew down reserve funds during the pandemic, around one-fifth (22%) delayed or canceled capital projects, and around one-fifth (18%) delayed maintenance. Owing to the essential nature of their work as well as systemic and short-term workforce challenges noted above, smaller percentages reduced staff hours (5%), laid off staff (2%), or reduced staff pay and/or benefits (2%). Utilities that took remedial actions like drawing down reserve funds, delaying capital projects, and delaying maintenance will continue to feel the effects of the pandemic on their operating budgets in the years ahead.

    - About a quarter (23%) of utilities in the nation experienced a net revenue loss during the reporting period and there were significant losses or gains for a small number of utilities. On average, net revenue was a positive 10%. The exception was AI and ANV utilities, with an average deficit/loss of -113%; this finding is driven by a handful of small Tribal utilities reporting losses of large magnitude. While the net revenue of less than one-quarter of utilities was negative, the average losses or deficits of the utilities with negative net revenue was substantial, averaging approximately 39% of revenue. Around

one-third (32%) of the nation's water and wastewater utilities had shortfalls in operating net revenue (i.e., lower than budgeted net revenue). The 95% confidence interval for the cumulative shortage at these utilities was an estimated $2.7 to $4.8 billion. Nearly half of the estimated national shortfall was incurred by CWSs serving a population of over 10,000. These operating net revenue estimates are subject to some uncertainty because many (over two-thirds) of the participating utilities did not provide financial data. In many cases, the reported data did not cover the full calendar year of 2020. Most of the survey respondents (64%) that provided revenue and expense data did not report data for the final quarter of the year, which included a spike in COVID-19 cases; therefore, the total operating net revenue shortfall for the year may be outside of the estimated range.

  - Among water and wastewater utilities in the nation that experienced lower operating revenue than budgeted, the most common COVID-19-related contributing factor was nonpayment of bills (affecting around 51%), followed by decreased use of services (affecting around 29%).

  - To ensure continuity of service during the pandemic and the associated economic downturn, around half of the nation's water and wastewater utilities (52%) suspended service shutoffs. In addition, many provided extensions on bill payment (44%) and waived late fees (36%). Approximately 65% of utilities took one or more steps such as these to ensure continuity of service.

- Around one-tenth (11%) of water and wastewater utilities have experienced issues related to **sample collection** during the pandemic. The most commonly cited issue, which affected 6% of utilities, was lack of access to approved monitoring locations.

- Similarly, around one tenth (12%) of water and wastewater utilities have experienced issues related to completion of required **laboratory analyses** during the pandemic. AI and ANV utilities have been particularly affected by sample transport delays and travel restrictions.

- The survey data indicate that only about 1% of water and wastewater utilities have experienced **cybersecurity** issues and concerns during the pandemic. Those that have experienced such issues tend to be larger organizations. Among utilities serving populations of 100,000 or more, 13% have experienced such issues or concerns, which ranged from email phishing scams and ransomware attacks to fraudulent unemployment claims. It is possible that survey results under-report known cybersecurity issues, since some victims might be reluctant to reveal that their systems have been compromised.

- As the pandemic continues, approximately half (52%, 51%, and 48%, respectively) of the nation's water and wastewater utilities have some level of ongoing concern about future supply chain, workforce, and financial issues. About one quarter (27% and 24%, respectively) have some level of concern about analytical support and cybersecurity issues.

- Survey respondents also stressed the importance of recognizing those in the water sector as essential workers and ensuring that they receive needed support and resources.

TABLE OF CONTENTS

ABBREVIATIONS

Abbreviation	Definition
AI utility	American Indian utility
ANV utility	Alaska Native Village utility
COOP	Continuity of Operations Plan
CWS	Community Water System
EPA	U.S. Environmental Protection Agency
PPE	Personal Protective Equipment
SCADA	Supervisory Control and Data Acquisition
WARN	Water and Wastewater Agency Response Network
WWTF	Wastewater Treatment Facility

From October through December 2020, the U.S. Environmental Protection Agency (EPA) conducted a survey of the water sector to obtain information about coronavirus disease (COVID-19) related needs. EPA performed this survey as part of its duties as the designated sector specific agency under Presidential Policy Directive 21: *Critical Infrastructure Security and Resilience* to help ensure the resiliency of the nation's drinking water and wastewater systems. The survey requested information on how the COVID-19 situation affected utility function across multiple areas, including chemical and equipment supply-chain, workforce, financial, sampling and analysis, and cybersecurity concerns. Survey information will guide the development of technical assistance that could help sustain water utility operations and support planning for the future.

The survey was sent out to a statistically representative sample of more than 6,000 of the nation's approximately 61,000 community water systems (CWSs), wastewater treatment facilities (WWTFs), and Tribal utilities that provide drinking water and/or wastewater services. Since Alaska Native Village (ANV) utilities face unique circumstances based on their distance from the lower 48 states and their often remote locations, the Tribal utilities in the survey were categorized as either Alaska Native Village (ANV) utilities or American Indian (AI) utilities. In this report, the CWSs, WWTFs, AI utilities, and ANV utilities are collectively referred to as "utilities."

The survey used a stratified random sample based on utility type (CWS, WWTF, AI utility, or ANV utility) and size (the size of the population served). The survey was national in scope and included utilities from every state and territory.

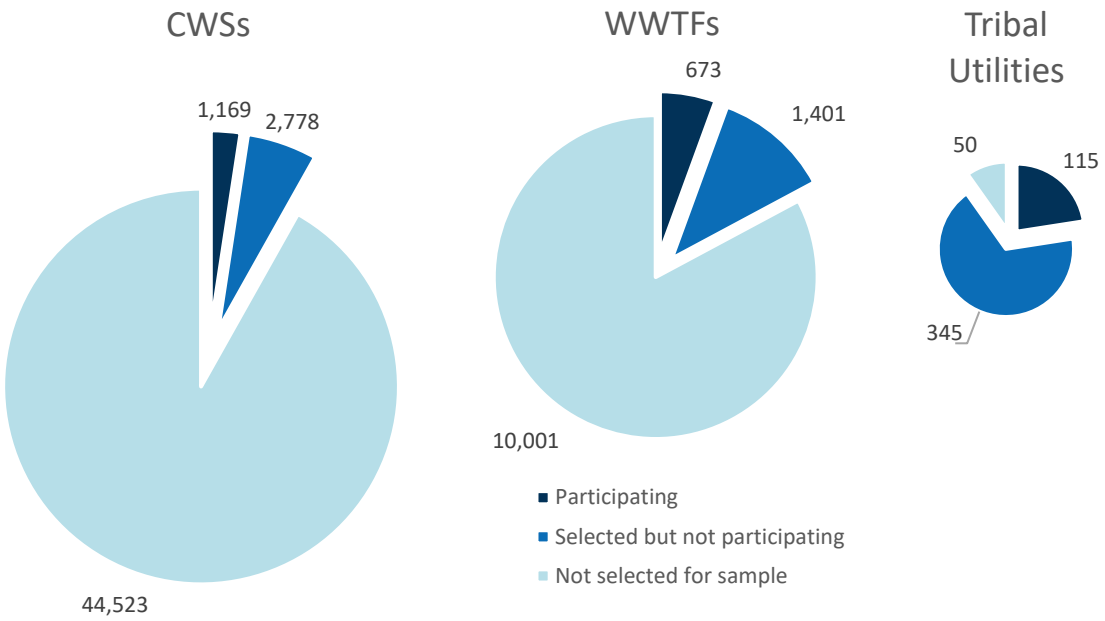
The survey was administered electronically. Links were distributed to selected utilities by email, starting on October 1, 2020, with all responses received by December 31, 2020. Responses to survey questions were received from 1,956 of the 6,481 utilities in the sample, or approximately 30%. The number of utilities in the nation, the size of the sample selected, and the number of final responses are shown in Table 1.1. As can be seen in the table and as illustrated in Figure 1.1, CWSs are the largest of the groups and provided the majority of responses. Since there are relatively few AI and ANV utilities (510 in all), EPA attempted to reach nearly all of them.

EPA conducted brief interviews with a sample of utilities that did not respond to the survey to assess the possibility of non-response bias. The follow-up interviews asked about their reasons for not responding and their assessment of the effect of COVID-19 on their operations. The responses to the interviews were generally consistent with the overall findings of the survey; therefore, EPA believes the potential non-response bias is small. (See Appendix A for more information on evaluation of non-response bias.)

Table 1.1. Inventory and Sample of Water and Wastewater Utilities for the 2020 COVID-19 Water Sector Survey

Sampling Stratum (Type of Service and Size of the Population Served)	Inventory of Utilities	Sample Size	Survey Respondents	Response Rate
CWS Less than 501	25,902	948	206	21.7%
CWS 501 - 3,300	12,623	933	249	26.7%
CWS 3,301 - 10,000	8,568	920	304	33.0%
CWS 10,001 - 100,000	670	567	199	35.1%
CWS Greater than 100,000	707	579	211	36.4%
Subtotal, CWS	***48,470***	***3,947***	***1,169***	***29.6%***
WWTF Less than 10,000	9,684	925	258	27.7%
WWTF 10,000 - 99,999	2,015	808	297	36.8%
WWTF 100,000 or more	354	319	114	35.7%
WWTF Size Unknown	22	22	4	18.2%
Subtotal, WWTF	***12,075***	***2,074***	***673***	***32.4%***
AI Less than 101	100	82	17	20.7%
AI 101 – 500	87	75	16	21.3%
AI 501 - 3,300	98	78	19	24.4%
AI 3,301 - 10,000	36	36	16	44.4%
AI Greater than 10,000	10	10	3	30.0%
Subtotal, AI Utilities	***331***	***281***	***71***	***25.3%***
ANV Less than 101	61	61	13	21.3%
ANV 101 – 500	90	90	22	24.4%
ANV 501 - 3,300	28	28	8	28.6%
Subtotal, ANV Utilities	***179***	***179***	***43***	***24.0%***
Total	***61,055***	***6,481***	***1,956***	***30.2%***

Figure 1.1: Participation by Sector

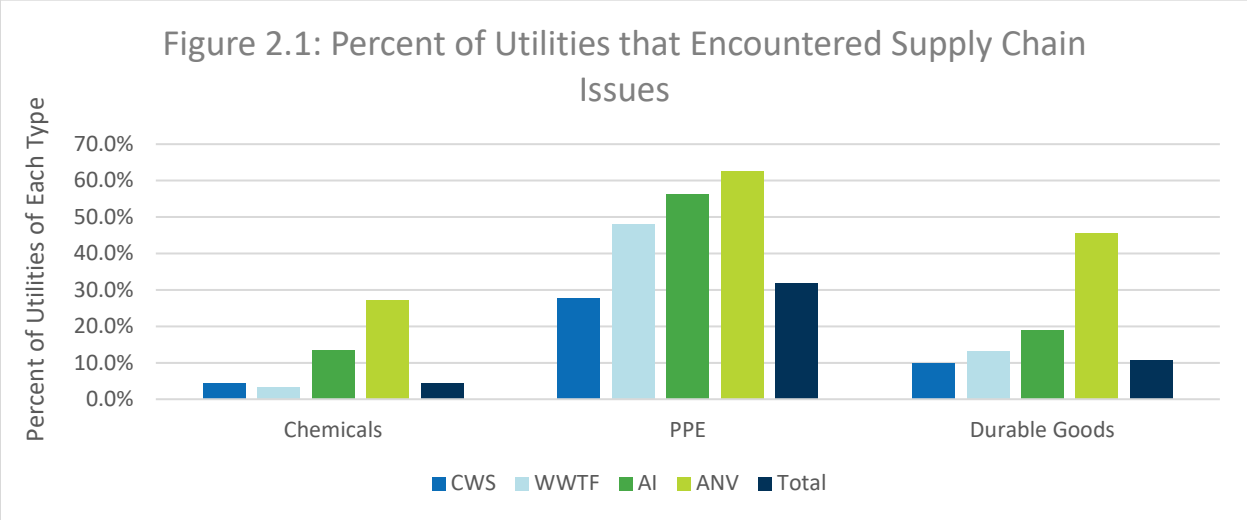


This report is organized by topic, following the outline of the survey itself. Appendix A provides more detail on the survey approach, including the statistical methodology and information about precision and quantification of uncertainty. Appendix B lists the survey questions. Appendices C-G contain detailed tables summarizing the responses to each survey question. The data tables in Appendices C-G present both point estimates (i.e., means and proportions) and confidence intervals. With the exception of confidence intervals for key dollar value estimates, confidence intervals are not presented directly in the text. However, when confidence intervals are particularly wide, due to the small sample size of subgroups of respondents, this fact is noted in the text.

The survey presents a snapshot of circumstances during the pandemic year of 2020. It cannot necessarily be assumed that all of the survey's findings are solely attributable to the pandemic or new in 2020. In a handful of instances (e.g., regarding workforce shortages), survey respondents specifically noted that the pandemic exacerbated pre-existing problems.

2.1 Issues Encountered and Severity

Overall, survey results indicate that 36% of the nation's water and wastewater utilities encountered some kind of shortage or supply chain issue in 2020. As shown in Figure 2.1, water and wastewater utilities had more trouble obtaining PPE (32% of "Total" utilities experienced shortages or supply chain disruptions) than treatment chemicals (4%) or durable goods such as pipes and valves (11%). PPE shortages were considerably more severe among WWTFs than CWSs, and shortages in all categories were most severe for AI and ANV utilities. Looking to the months ahead, the survey indicated that utilities have diminished concern about the availability of PPE (19%), but increased concern about the availability of chemicals (12%) and durable goods (18%). The discussion that follows provides more detailed findings, first for chemicals, then for PPE, and then for durable goods and other critical equipment and supplies.

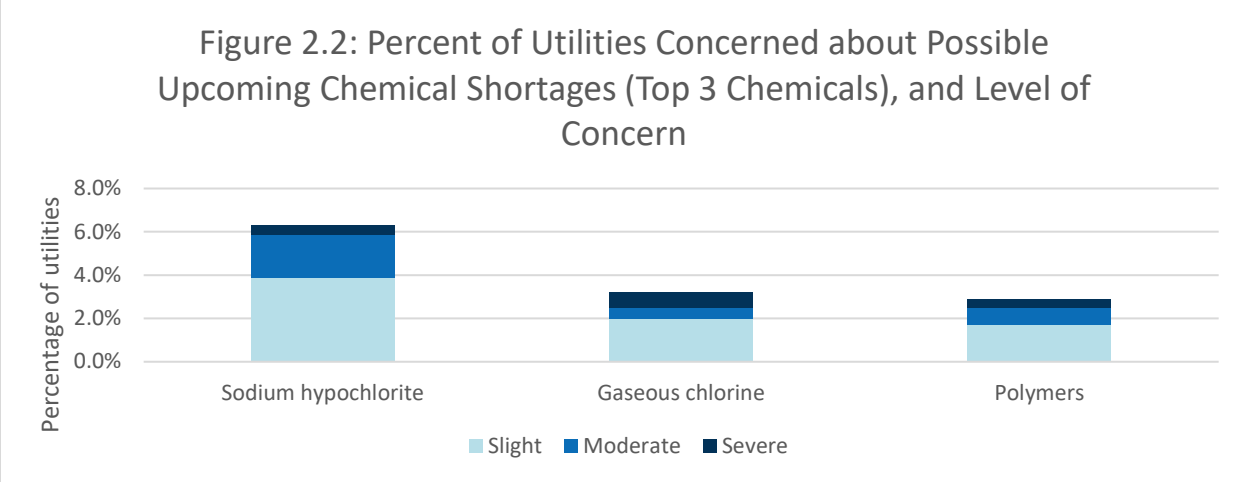


Among CWSs and WWTFs, supply chain disruptions involving treatment chemicals were not widespread. No more than 2% in either group experienced disruptions involving any given chemical. Concerns about future chemical availability among CWSs are highest for sodium hypochlorite (6%), gaseous chlorine (3%), and polymers (2%); among WWTFs concerns were highest for the same three chemicals, sodium hypochlorite (6%), polymers (6%), and gaseous chlorine (3%). Concerns about future disruptions are higher among larger WWTFs than smaller WWTFs. AI utilities have already experienced significant disruptions involving sodium hypochlorite (8%) and are most concerned about future disruptions involving sodium hypochlorite (15%), polymers (8%), gaseous chlorine (6%), and ferric chloride (5%). ANV utilities have already experienced significant disruptions involving polymers (13%), potassium permanganate (11%),

"[Suppliers] have limited the amount of chlorine gas cylinders we can receive per delivery."

"Process chemical (like polymers for thickening) supply chains seem to have a high potential for disruption and delay. [This] is the most likely way in which COVID-19 could disrupt our process or trigger a violation of some sort."

gaseous chlorine (8%), sodium hydroxide (8%), and lime (8%), among others, and anticipate even greater difficulties in obtaining all chemicals, with particularly high concern about future availability of polymers (26%), sodium hypochlorite (17%) and gaseous chlorine (11%). Figure 2.2 shows overall water sector concern about future availability of the three chemicals most commonly identified by survey participants: sodium hypochlorite (6%), gaseous chlorine (3%), and polymers (3%). Note that some of these estimates of chemical shortages, especially for AI and ANV utilities, have fairly wide confidence intervals. See Appendix A for information about survey precision and Appendices C-G for confidence intervals associated with these findings about chemical shortages.



Among PPE, utilities had the most difficulty acquiring sanitizing wipes, sprays, and gels (27% experienced shortages or supply chain disruption), N95 respirators and elastomeric respirators (24%), nitrile and latex gloves (23%), and other types of masks (21%). PPE availability was a greater concern for larger utilities than smaller utilities. Concerns were diminishing at the time of the survey, but 13-16% of utilities were still expecting shortages of these types of items in the months ahead. Several survey participants commented that PPE shortages were worst during the first wave of the pandemic.

Most utilities did not report significant problems with acquiring durable goods and other critical equipment and supplies. The largest problems involved acquiring pipes (6% of utilities experienced some level of supply chain disruption), pumps (6%), valves (5%), and motors (4%). Availability of these items was a greater concern for larger utilities than smaller utilities. On the whole, levels of concern were rising. Figure 2.3 shows levels of concern about potential upcoming shortages for a range of goods. Several survey participants commented that they had trouble sourcing additional items such as laptops, web cameras, and headsets for telework.

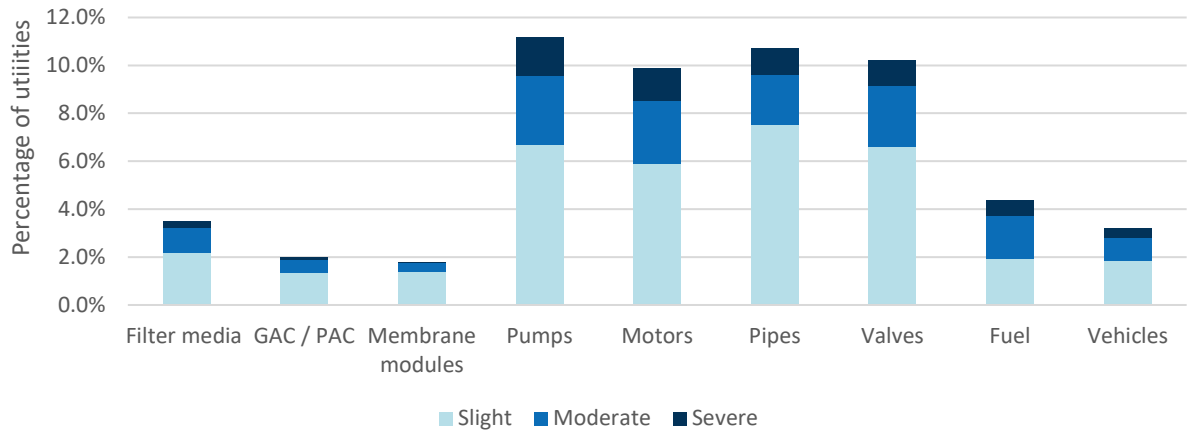
"[We experienced] mainly a shortage of protective masks, sanitizers and disinfectants early in the crisis."

"[It took a] concerted company-wide effort to source/find/ purchase appropriate safety [gear and] PPE."

"With PPE such as N95 respirators and Tyvek suits being reserved for medical personnel only, we had to stop doing some sewer work as our crew no longer had the required safety gear."

"We are in the middle of a major expansion and the bid prices and delivery of materials such as pumps have been affected."

Figure 2.3: Percentage of Utilities Concerned about Shortages of Goods and Supplies in Upcoming Months, and Level of Concern



2.2 Causes

The most common reported cause of chemical shortages was supplier delays, followed by distribution difficulties. Many CWSs trying to obtain carbon dioxide (62% of them) found that it was simply unavailable from suppliers. A significant proportion of high-grade carbon dioxide is co-produced with ethanol and, as has been widely reported, reduced demand for fuel led to reduced ethanol production in 2020. Looking into the future, water sector utilities have increasing concerns about chemical supply availability and rising prices.

Utilities attributed PPE shortages primarily to delays and unavailability from suppliers, and they are largely concerned about those same factors when they anticipate future PPE shortages. Some also mentioned PPE price increases as a concern.

"Some items purchased would normally take two weeks to deliver, now it takes four to six weeks"

"Suppliers noting difficulty in finding . . . items. Their inventory and supply seem to be dwindling."

"Supplier's workforce . . . is either reduced or working around illness."

"We were able to get the supplies we needed, but it cost a lot more."

Responses for durable goods and other critical equipment and supplies mirrored those for chemicals. The leading contributing factor for most items was supplier delays, followed by distribution difficulties. One notable exception was among WWTFs, where distribution difficulties were the leading cause of shortages of membrane modules (70%). Looking ahead, there is increased concern about unavailability from suppliers and about rising prices, as well as continued concern about supplier delays.

2.3 Actions Taken or Planned

When utilities experienced chemical supply concerns, most were able to cope by drawing down current inventory. In the case of sodium hypochlorite, sodium hydroxide, and ferric chloride, a significant number of those who had supply problems (28%, 19%, and 13%, respectively) switched to alternate chemicals or procedures (e.g., switching from 6% hypochlorite to 12%, or from ferric chloride to ferric

sulfate, or adjusting to the minimum dosage required). Those who anticipate future chemical supply concerns are still planning to draw down current inventory, but they are also increasing their efforts to seek alternate suppliers and utilize mutual aid support networks like Water and Wastewater Agency Response Networks (WARNs). Utilities rarely indicated that they coordinated directly with local emergency management agencies about chemical shortages.

For PPE shortages, drawing down inventory and seeking alternate suppliers were the most commonly reported response strategies. Masks (N95 respirators and others) were the type of PPE most commonly requested from local emergency management agencies.

For durable goods and other critical equipment and supplies, drawing down inventory and seeking alternate suppliers were the most commonly reported coping strategies. Seeking alternate suppliers was the strategy most commonly reported for future shortages.

"[We] made requests through the municipal government to the local and then state emergency management groups."

"Contacts and dialogue was made early on with our suppliers."

"Our Tribe and local emergency agencies have done a great job of planning and distributing PPE, supplies, etc."

"Water industry personnel should rank with first responders to receive supplies."

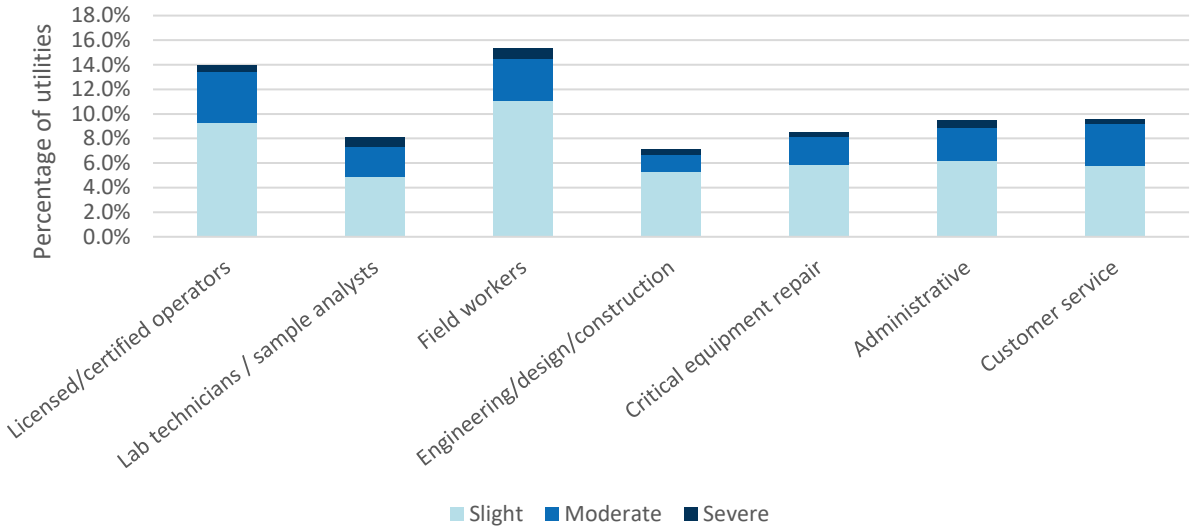
About one-eighth of CWSs (13%), one-fifth of WWTFs (21%), and a majority of AI utilities (57%) and ANV utilities (60%) sought help from local, state, or Tribal emergency operations centers, primacy agencies, or similar organizations. Larger CWSs and WWTFs were more likely to seek help than smaller CWSs and WWTFs. Of those that did seek help, a majority of CWS, WWTF and AI utility respondents said their requests were "entirely filled," while a majority of ANV utility respondents said their requests were "partly fulfilled." A small number of respondents in each group said they did not request help, but they would have if the option had been available or if they had known.

3. WORKFORCE ISSUES

3.1 Issues Encountered and Severity

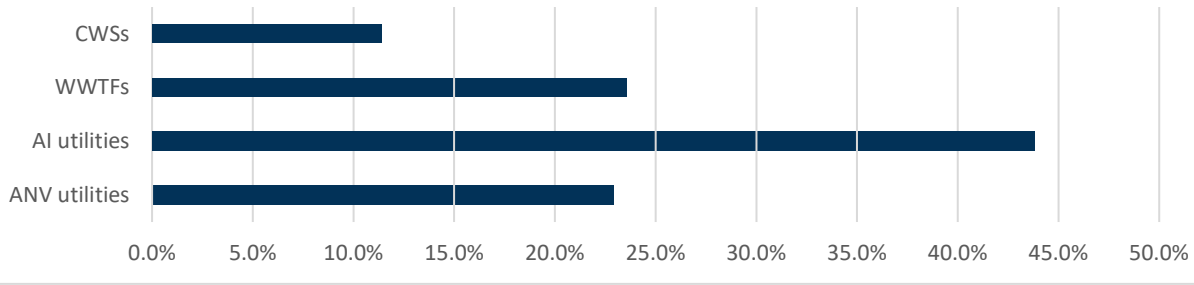
The survey shows that around one quarter (27%) of water and wastewater utilities experienced shortages of key personnel (a term that includes both staff and contractors performing critical functions to maintain operations). As shown in Figure 3.1, the categories most reported as subject to shortages were field workers (15%) and licensed and certified operators (14%). Around 4% of utilities had shortages in at least three categories, and 1% had shortages in all seven listed categories.

Figure 3.1. Percentage of Utilities that Experienced Workforce Shortages, by Personnel Type



In general, CWSs reported the lowest rates of personnel shortages and AI utilities reported the highest (see Figure 3.2, which focuses on licensed and certified operators).

Figure 3.2: Percentage of Utilities that Experienced a Shortage of Licensed or Certified Operators, by Sector



Larger utilities (serving more than 10,000 customers) were more likely to experience workforce concerns than smaller utilities. This is true of all worker categories, as shown in Figure 3.3. For licensed and certified operators, it is true of CWSs and WWTPs but not AI utilities, as shown in Figure 3.4.

Figure 3.3. Percentage of Utilities that Experienced Workforce Shortages, by Personnel Type and Utility Size

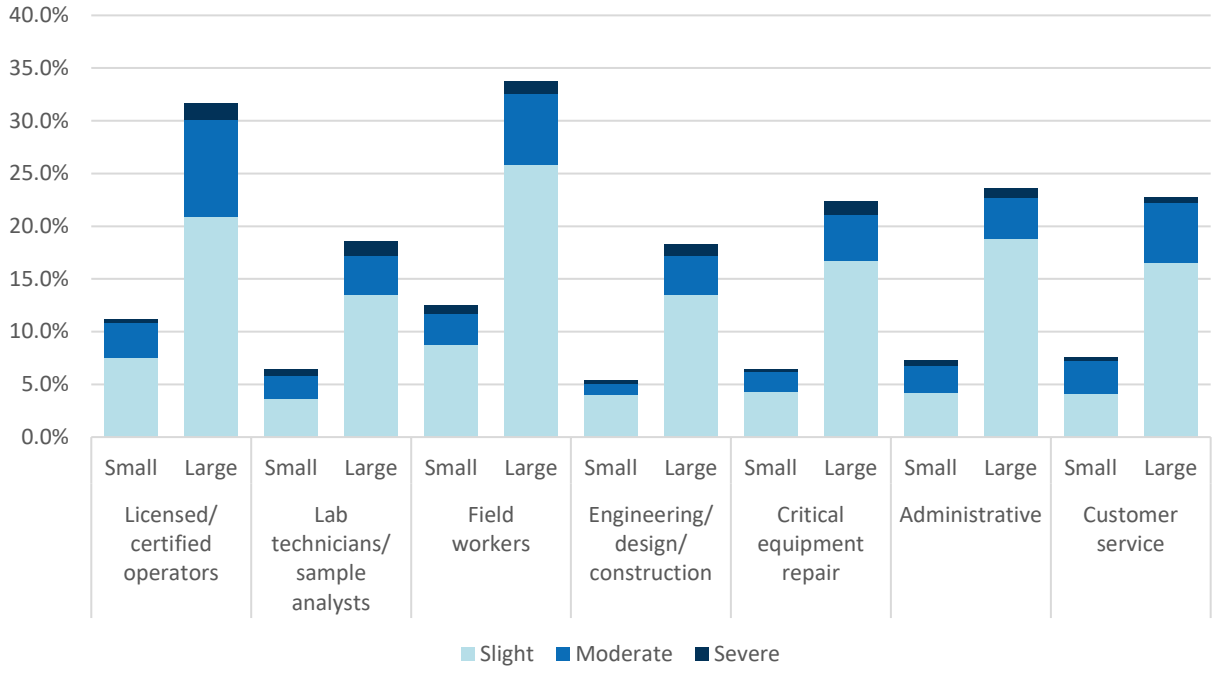
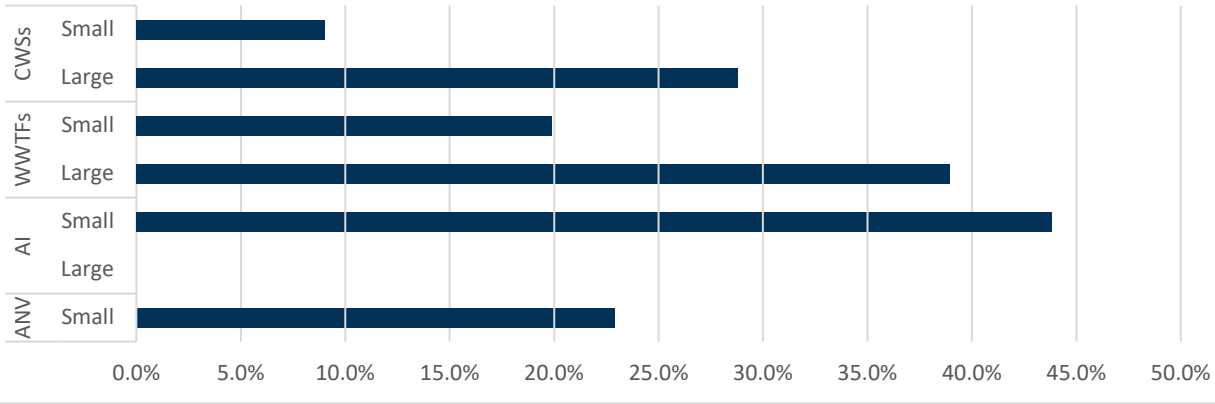


Figure 3.4: Percentage of Utilities that Experienced a Shortage of Licensed or Certified Operators, by Sector and Utility Size



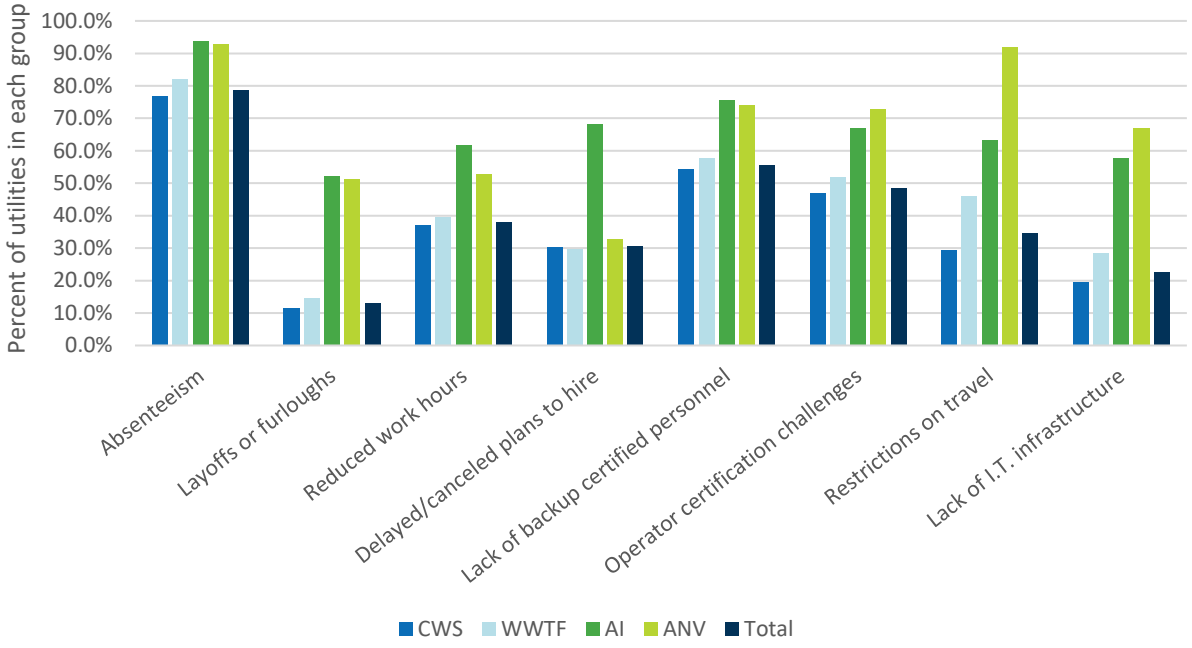
When asked about anticipated workforce shortages in the coming months, respondents gave very similar answers to those about shortages already experienced, indicating that there is no immediate end in sight for the staffing shortages identified in the survey.

> *"We are a small water utility with limited staff. If someone gets ill with COVID-19 and the rest of us had to quarantine, this would have a huge impact."*

3.2 Causes

As shown in Figure 3.5, the overall leading cause of staffing shortages was absenteeism (due to factors such as illness, care of family members, daycare closure, and virtual schooling). Among CWSs and WWTFs, other commonly cited causes included lack of backup certified personnel and the inability of operators to obtain or maintain needed certifications. All of the factors listed affected AI and ANV utilities most severely. Restrictions on travel was the leading factor for ANV utilities, and AI utilities in particular had difficulty hiring to fill vacancies.

Figure 3.5. Factors Contribuing to Personnel Shortages



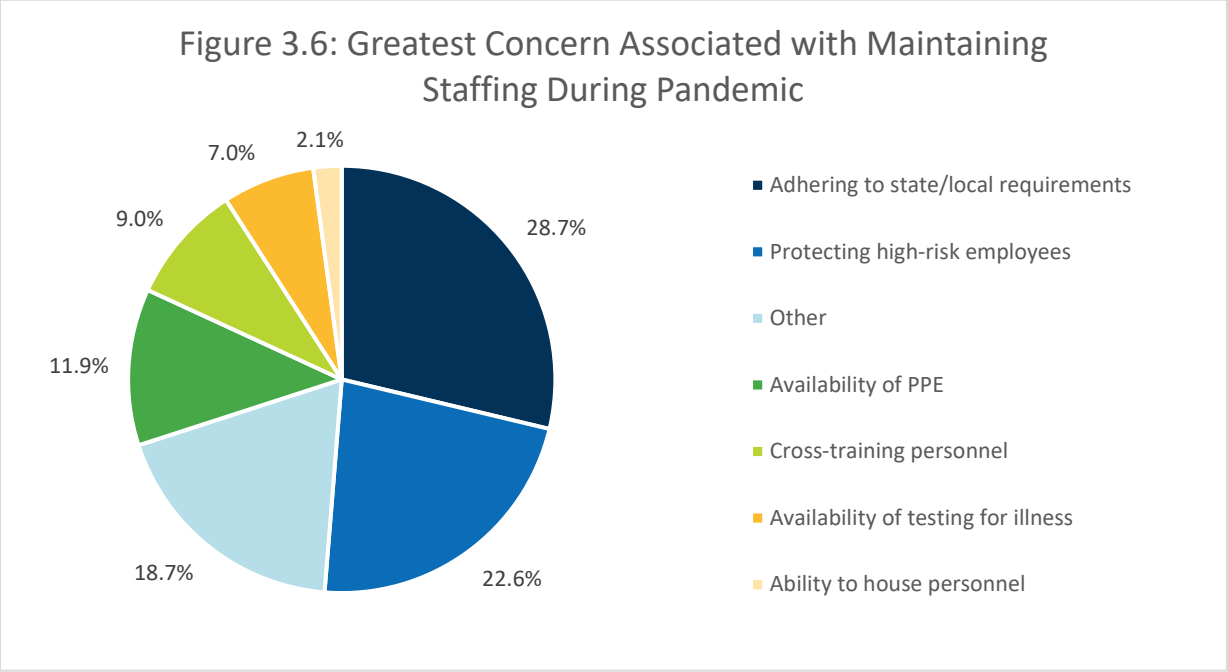
3.3 Actions Taken or Planned

The most common strategies utilities used to cope with staffing shortages were delaying non-critical work (38%), decreasing staffing levels and making changes in shift work (26%), using telework for job functions that could be performed remotely (26%), and increasing reliance on technologies such as live video feeds (26%). In most cases these strategies were reported to be effective.

> *"Availability of SCADA, remote work, and staggering shifts and personnel was extremely beneficial in the success of maintaining our drinking water supply."*

3.4 Areas of Greatest Concern

Participants were asked to identify their greatest concern associated with staffing during the pandemic. Overall, participants were concerned about a range of workforce issues and no one issue was dominant. As shown in Figure 3.6, adhering to changing state and local requirements was the most common concern (29%), followed by protecting high-risk employees (23%). Among those who selected "Other," one common theme was concern about maintaining operations if most or all staff were sick or required to quarantine. For AI utilities, cross-training of personnel was also among the top concerns (17% of responses from AI utilities), and ANV utilities were particularly concerned about availability of COVID-19 testing for personnel (21% of responses from ANV utilities).



Given an opportunity to provide comments on their workforce concerns, several survey participants pointed out that they were already understaffed before the pandemic. Other participants noted that water and wastewater staff are essential workers and that during this pandemic they have not always received the corresponding recognition and resources.

4. FINANCIAL ISSUES

The effects of the pandemic on water and wastewater utility finances varied greatly across utilities. This is to be expected in such a large and diverse sector that provides a range of services through various business models to diverse customer bases. Approximately 48% of utilities took some action to mitigate potential decreases in cash flow. Utilities that took remedial actions like drawing down reserve funds, delaying capital projects, and delaying maintenance will continue to feel the effects of the pandemic on their operating budgets in the years ahead. As described below, net revenue, calculated as revenue minus expenses over part of the year, was negative for about one-quarter (23%) of utilities and positive for three-quarters (77%) of utilities during 2020.

"Really struggling with financial issues."

"We are lucky, we have not been impacted money wise."

"Increased demand from customers due to staying at home."

"Those communities we serve that have a larger commercial base have been hit hard."

In the financial issues section of the survey, utilities were asked to provide their *budgeted* revenue and expenses during the pandemic and their estimates of their *anticipated* revenue and expenses (see findings in Section 4.1, below). If their anticipated revenue was lower than their budgeted revenue, or if their anticipated expenses exceeded their budgeted expense, they were asked additional follow-up questions about the reasons for the differences (Section 4.2). Not every utility responded to these quantitative financial questions: fewer than 600 of the 1,956 respondents provided information about budgeted and actual revenue and expenses. Utilities were also asked additional qualitative questions about their financial outlook (Section 4.3) and the actions they took to respond to the financial effects of the COVID-19 pandemic (Section 4.4). Most survey participants (nearly 1,600) responded to these qualitative questions. The implications of the relatively low response rate of the quantitative financial questions are described below.

4.1 Operating Budget Shortfalls

A subset of water and wastewater utilities provided information about their budgeted and actual revenue and expenses in 2020 (though accounting periods differed, as discussed below). EPA used these data to estimate the potential operating revenue loss experienced by utilities during the reported time period. The pandemic was not the only factor affecting utilities' finances in 2020, but the survey did ask utilities to identify pandemic-related factors that contributed to higher operating expenses or lower operating revenue (described in section 4.2, below).

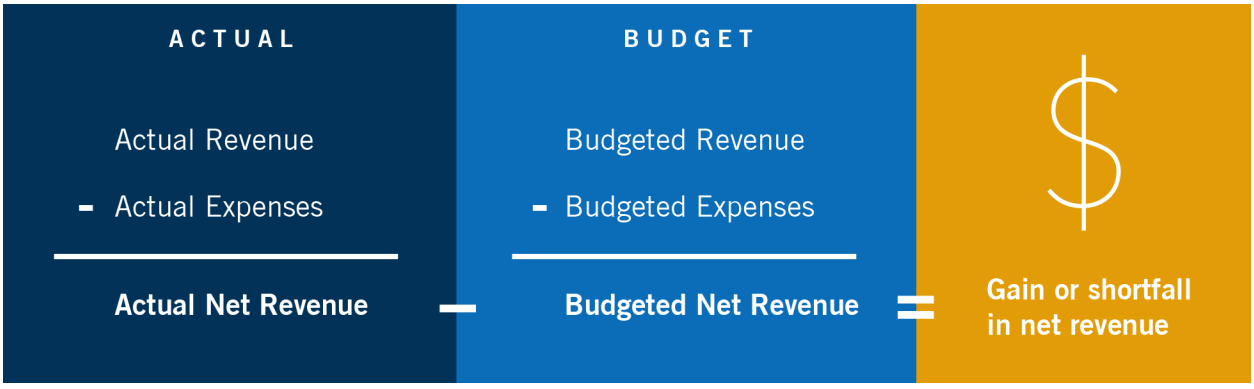
As described above, not every utility responded to the quantitative financial questions: fewer than 600 of the 1,956 respondents provided information about budgeted and actual revenue and expenses. The national estimates of water and wastewater utilities' net revenue and other financial parameters are based on this subset of responses. The relatively low response rate raises two potential concerns. First, it raises questions of possible bias: Were the survey participants who declined to provide revenue and expense data more or less likely to face revenue trouble than those who did provide data? A simple comparison between how these two groups (those that did and those that did not provide financial data) answered other qualitative financial questions, such as their financial outlook in the months

ahead, did not indicate any clear difference between the two. However, the possibility of bias should still be kept in mind when interpreting the results. Second, a lower response rate means less precision. A relatively small sample can be used to produce national estimates if the sample is representative, but the uncertainty introduced by sampling will be larger in small samples than larger samples. The precision has been quantified and shown through confidence intervals. For key findings in section 4.1, confidence intervals are presented in the report. Confidence intervals are also presented in Appendices C-G.

The water sector includes private investor-owned utilities, small privately owned companies, and utilities owned by states, municipalities, and Tribes. Private for-profit enterprises usually refer to the difference between revenue and expenses as profit or losses, while public enterprises usually refer to the difference as surpluses or deficits. In this section, we generally call the difference between revenue and expenses "net revenue," and apply it to both private and public enterprises. When referring to the collective losses of privately owned systems and deficits of publicly owned systems, we use the term "deficits/losses." EPA calculated net revenue (the difference between revenue and expenses) for each of the 541 utilities that reported these values, and then calculated net revenue as a percentage of revenue (net revenue divided by revenue) to more easily compare outcomes across utilities of different size. EPA also compared *actual* net revenue to *budgeted* net revenue, identifying a gain or shortfall in net revenue (measured as actual net revenue minus budgeted net revenue).

Figure 4.1 illustrates the relationships among budgeted and actual revenue and expenses. Actual net revenue (in the first column of the figure) is the difference actual revenue and expenses. By comparing actual net revenue to budgeted net revenue the second column of the figure), we can evaluate how the actual experience deviated from the plans for the year. This difference is useful because a utility with positive net revenue may still have experienced a loss if that net revenue was lower than budgeted. Similarly, a utility with negative net revenue may have a deficit or loss that is less than expected. While the simple measure of net revenue shows the actual changes at each utility, comparison of actual and budgeted net revenue better reveals the revenue impact of unexpected challenges in 2020.

Figure 4.1: Calculation of Gain or Shortfall in New Revenue



Note that the accounting periods were not uniform among respondents. Utilities reported actual and budgeted expenses and revenue from January 2020 to "present day," which was defined according to each utility's financial reporting period. Very few reported data for the full calendar year, and almost two-thirds (64%) of the systems that provided revenue and expense data used a cutoff day for "present

day" that was earlier than October 1, 2020. Therefore, the financial changes for the full twelve months of 2020 may be different than reported in the survey.

The net revenue results are ordered from the greatest loss to the greatest gain in Figure 4.2. The figure shows that about a quarter (23%) of utilities in the nation experienced a net revenue loss during the reporting period and that there were significant losses or gains for a small number of utilities at both ends of the graph. Because only a subset of the sample answered the questions about revenue and expenses, the estimate of 23% experiencing a net revenue loss is somewhat uncertain. The 95 percent confidence interval for the estimate is 18% to 29%.[1] Note that net revenue does not capture the full story of the effect of the pandemic on utility finances. For example, as discussed in section 4.4 below, utilities reported taking actions to mitigate decreases in cash flow, such as drawing down cash reserves, postponing capital improvement projects, and deferring maintenance activities. These remedial actions will constrain utilities' options and increase costs in future years, but they will not be reflected in the utilities' 2020 net revenue.

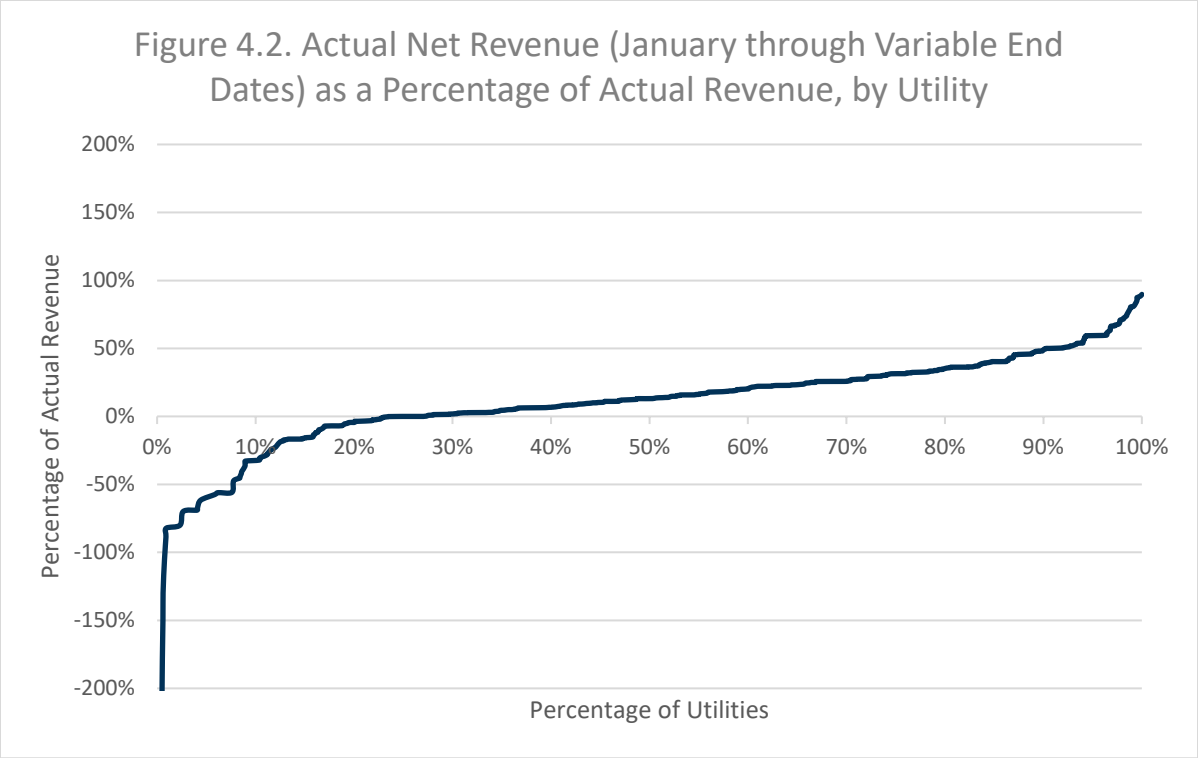


Table 4.1 shows estimates of net revenue across several categories among the nation's utilities. The first two columns show average net revenue and the average of each utility's net revenue as a percentage of its total revenue, the latter of which allows a comparison of outcomes across utilities of different type and size. On average, utilities in every category had positive net revenue. The columns on the right show results for the estimated 23% of utilities with deficits/losses. The third column shows the average loss per utility with a deficit/loss, and the final column shows the average deficit/loss as a percentage of the utilities' total revenue, again, the latter of which allows a comparison of outcomes across utilities of

[1] That is: there is a 95% chance that the reported interval of 18% to 29% includes the true percentage of utilities in the nation experiencing a net revenue loss in the reporting period. For more on confidence intervals, see Appendix A.

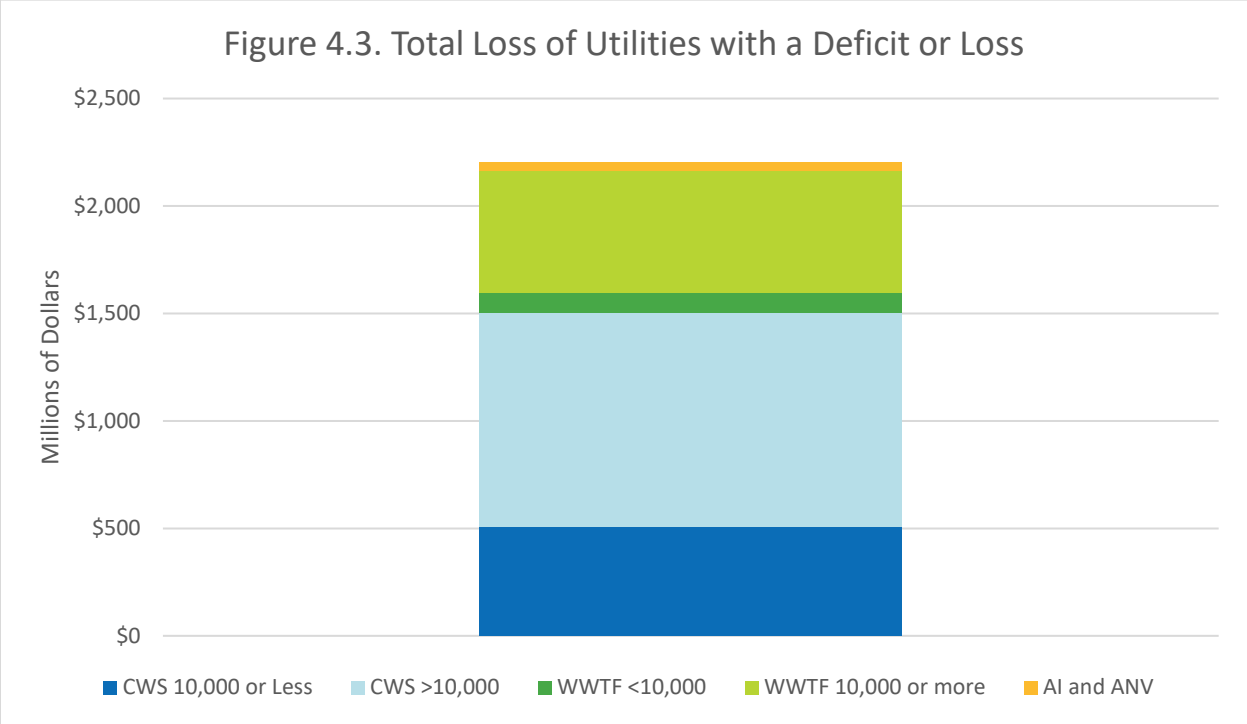
different size. On average, net revenue was a healthy positive 10%. The exception was AI and ANV utilities, with an average deficit/loss of -113%. This finding is driven by a handful of small Tribal utilities reporting losses of large magnitude. While the net revenue of less than one-quarter of utilities was negative, the average losses or deficits of the utilities with negative net revenue was substantial, averaging approximately 39% of revenue. Among utilities with deficits or losses, large organizations (WWTFs serving 10,000 or more and CWSs serving over 10,000) had the largest average deficits/losses in dollar terms. In percentage terms, tribal utilities had the severest average deficits/losses, followed by WWTFs serving under 10,000 with deficits/losses.

From an ANV utility: "Overall less revenue is coming in and general expenses, shipping, cost of supplies are increasing. Delays in shipping also slow things down greatly."

Table 4.1. Average Net Revenue and Deficit/Loss (Actual Revenue versus Actual Expenses)

	All Utilities		Only Utilities with a Deficit/Loss	
Stratum	Average Net Revenue	Average of Net Revenue as % of Revenue	Average Deficit/Loss	Average of Deficit/Loss as % of Revenue
CWS 10,000 or Less	$68,000	8%	-$46,000	-35%
CWS Greater than 10,000	$3,943,000	16%	-$1,066,000	-34%
WWTF Less than 10,000	$91,000	17%	-$52,000	-42%
WWTF 10,000 or more	$3,368,000	23%	-$1,175,000	-13%
AI and ANV	$8,000	-113%	-$256,000	-397%
Total	**$578,000**	**10%**	**-$154,000**	**-39%**

As illustrated in Figure 4.3, the total deficit/loss for all utilities that experienced a deficit/loss is $2.2 billion, which is approximately 17% of their revenue for the period. The associated 95 percent confidence interval is $1.5 billion to $3.1 billion. CWSs account for most of the total deficits/losses. The deficits/losses of large CWSs, those serving a population of over 10,000, add up to an estimated $995 million; this accounts for just under half the total estimated deficits/losses.



EPA also compared actual net revenue to budgeted net revenue, identifying a gain or shortfall in net revenue (measured as actual net revenue minus budgeted net revenue). This analysis was performed using data from the 541 utilities that provided all the data needed to perform the calculations (i.e., actual and budgeted revenue and expenses).

As illustrated in Figure 4.4, approximately a third (32%) of the nation's water and wastewater utilities had lower net revenue than budgeted. The associated 95 percent confidence interval is 27% to 40%. The figure shows that in most cases actual net revenue did not deviate much from budgeted net revenue (on a percentage basis). On the margins there were some extreme cases where net revenue was much higher or lower than budgeted. Note that this measure, like net revenue itself (discussed above), does not capture the full financial effects of pandemic-related disruptions in 2020. As mentioned above and as will be discussed in more detail in section 4.4 below, utilities reported having taken a variety of actions to mitigate decreased cash flows in response to the pandemic. These measures included drawing down reserves, delaying and cancelling capital projects, and deferring maintenance. In addition, some survey participants reported that balancing their budgets required reducing staff. Together, the budget information and the information about actions taken by utilities to reduce potential financial impacts tell a more complete story of utilities' financial situations in 2020 than either element alone.

> *"Cancelled a previously approved rate increase, which removed two positions from the budget."*

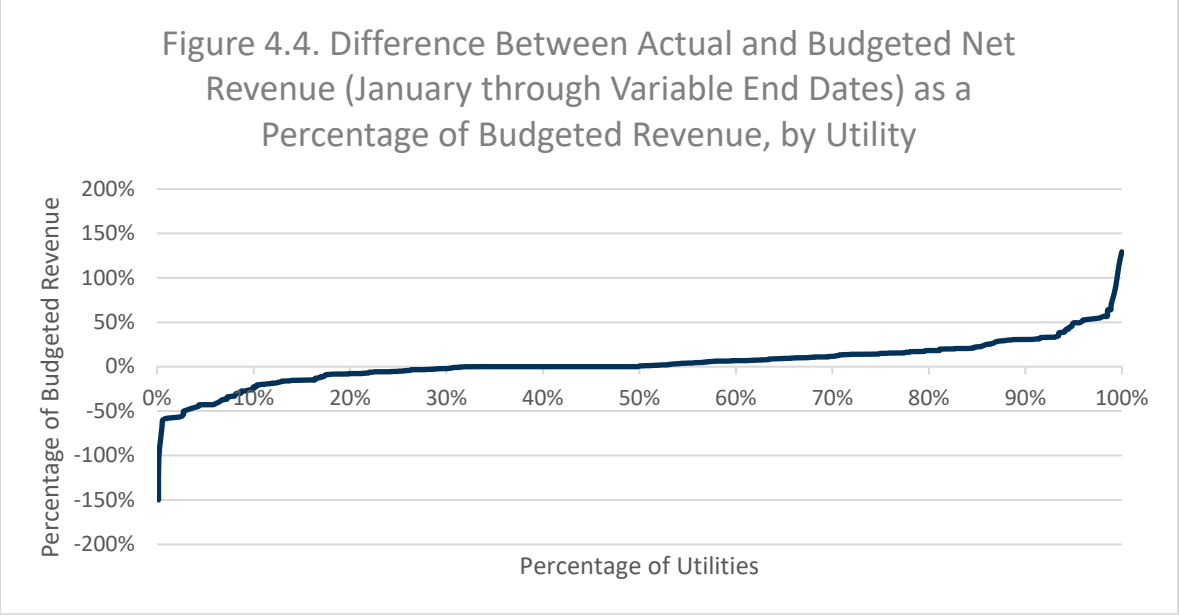


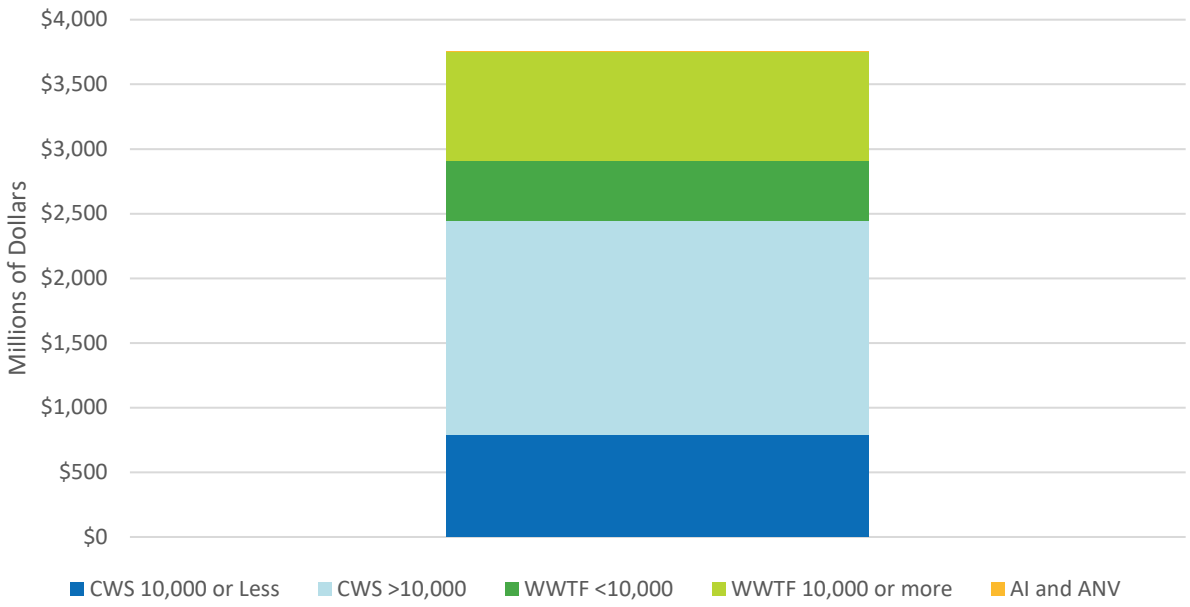
Table 4.2 compares estimates of budgeted and actual average net revenue and average shortfalls by category among the nation's utilities. The first column shows the average difference between actual and budgeted net revenue. The second column shows the difference as a percentage of budgeted net revenue. In most categories, actual average net revenue was higher than budgeted, but that was not the case for WWTFs serving less than 10,000 people. The columns on the right show results for only those utilities with net revenue that fell short of budgeted net revenue. Overall, water sector utility net revenue was modestly higher than budgeted (4% on average). Among the 32% of utilities with a shortfall in net revenue, shortfalls ranged from -8% on average for WWTFs serving populations to over 10,000 to -40% on average for AI and ANV utilities.

Table 4.2. Actual Net Revenue versus Budgeted Net Revenue

	All Utilities		Only Utilities with a Shortfall (Actual Net Revenue Less Than Budgeted Net Revenue)	
Stratum	**Average of Difference between Actual and Budgeted Net Revenue**	**Average of Difference between Actual and Budgeted Net Revenue as % of Budgeted Net Revenue**	**Average Shortfall**	**Average of Shortfall as a % of Budgeted Net Revenue**
CWS 10,000 or Less	$12,000	3%	-$61,000	-22%
CWS Greater than 10,000	$1,045,000	10%	-$984,000	-12%
WWTF Less than 10,000	-$9,000	3%	-$117,000	-19%
WWTF 10,000 or more	$302,000	5%	-$977,000	-8%
AI and ANV	$38,000	2%	-$37,000	-40%
Total	**$121,000**	**4%**	**-$193,000**	**-20%**

Among the utilities with net revenue that was lower than budgeted, the estimated cumulative national shortfall was $3.8 billion, as shown in Figure 4.5. The 95 percent confidence interval is $2.7 billion to $4.8 billion. In dollar terms, large CWSs stand out as having shortfalls accounting for an estimated $1.7 billion—nearly half of the total $3.8 billion. CWSs and WWTFs serving less than 10,000 people incurred approximately one-third of the shortfall. As described at the beginning of this section, many of the respondents did not provide data for the full year. Almost two-thirds of the survey respondents that provided revenue and expense data did not report data for the final quarter of 2020, which included a surge in COVID-19 cases. Therefore, the shortfall for the full year could fall outside of the estimated range of $2.7 to $4.8 billion.

Figure 4.5. Total Shortfall of Utilities with a Shortfall



4.2 Factors Contributing to Lower Revenue or Higher Expenses

The 541 survey participants that provided revenue and expense data (summarized in section 4.1, above) were asked follow-up questions about factors contributing to lower revenue and/or higher expenses if their financial data indicated that they were experiencing those concerns. Due to the relatively low number of responses to these questions, the points about precision and potential bias discussed in section 4.1 apply to the findings presented here as well. Confidence intervals for quantitative findings presented in this section are found in the data tables in Appendices C-G.

Among water and wastewater utilities in the nation that experienced lower operating revenue than budgeted, survey responses indicate that nonpayment of bills was the most common COVID-19-related contributing factor (see Figure 4.6). For approximately 51% of utilities with lower than expected revenue, nonpayment of bills was a

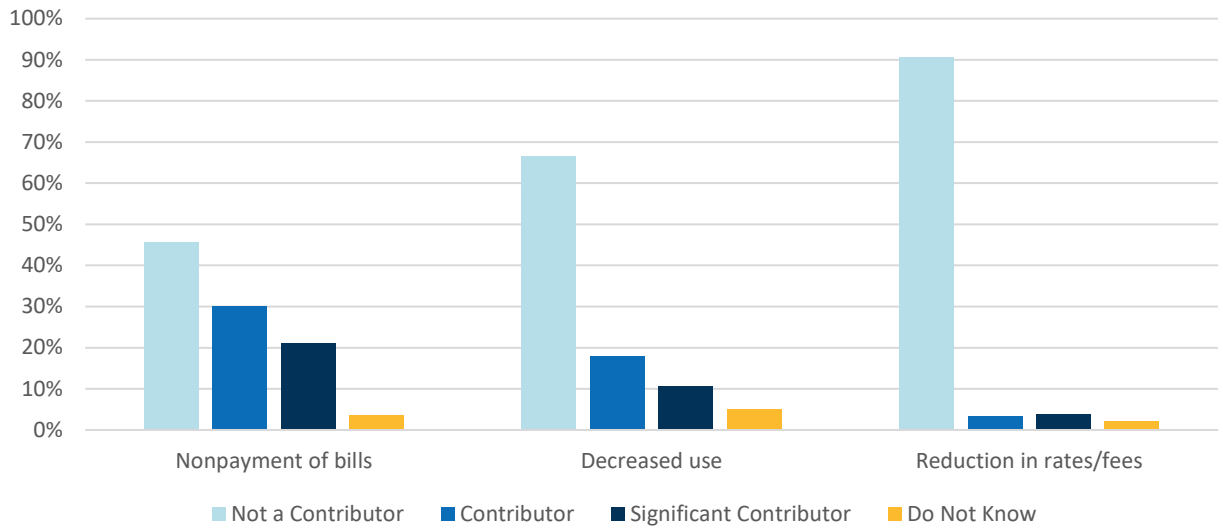
"The lack of collection of past due bills . . . and generally slowing of payments by customers has really impacted the utility cash flow and income these past months."

"We also saw a [shortfall] in revenue due to shut down in construction/ development [and fewer than expected] new meter sets."

"Not able to hold public meetings to facilitate a rate increase."

"contributor" (30%) or a "significant contributor" (21%). These results do not differ substantially among the different utility types. The second-most-commonly cited factor was decreased use of services. This affected approximately 29% of utilities, being cited as a "contributor" by 18% of utilities and a "significant contributor" by 11% of utilities. Reductions in rates and fees did not contribute notably to utilities' revenue issues.

Figure 4.6. COVID-19-Related Factors that Contributed to Lower Operating Revenue Than Budgeted



Among utilities that experienced higher operating expenses than budgeted, the most significant COVID-19-related factor was consumables (see Figure 4.7), a category that includes chemicals, filtration media, and other consumable supplies needed for operations, and could also include items like hand sanitizer and disinfectant wipes that were required for pandemic response (if they were not considered PPE). Consumables were a "contributor" (33%) or a "significant contributor" (13%) at 46% of utilities with higher than budgeted costs. Lesser but still significant factors included personnel costs (e.g., overtime, increased hours), utilities costs (e.g., electricity, fuel), and PPE (e.g., cloth masks). See section 2 of this report for more information on difficulties utilities encountered in obtaining chemicals, PPE, and other items.

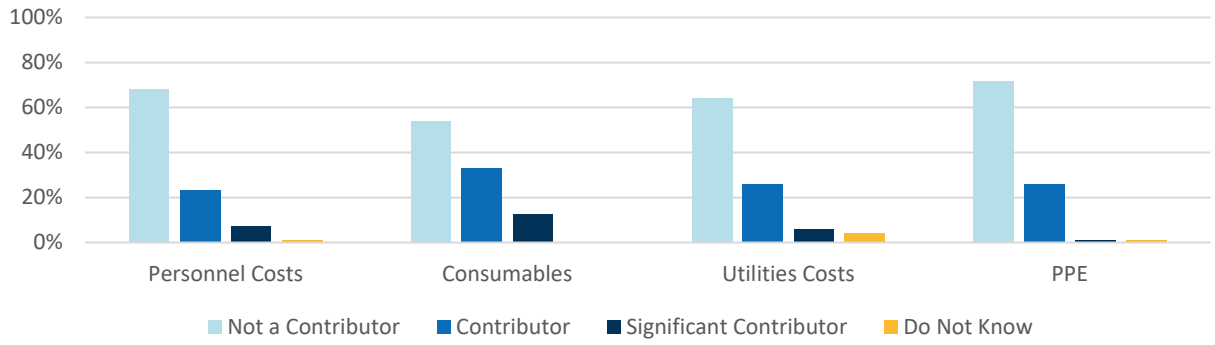
"Unplanned funds used for COVID testing . . . has been a major impact."

"Our company paid all employees' wages during our half-staff times. . . . So this made our expenses go up."

On capital expenses: "Costs and access [to] materials significantly impact project expenses. Low interest rates help."

On wastewater treatment expenses: "When people stayed home more, we noticed an increase in flow and then the increase in grease. It cost us more to get rid of the grease."

Figure 4.7. Pandemic-related Factors that Contributed to Higher Operating Expenses Than Budgeted



4.3 Financial Outlook

EPA asked all survey participants (regardless of whether they provided financial data) whether they expected their financial situation for the remainder of 2020 to improve, worsen, or stay about the same compared to the January-to-present timeframe. The results indicate that most of the nation's water and wastewater utilities expected their financial situation to stay about the same for operating revenue (69%) and operating expenses (74%) for the remainder of 2020. Small proportions of utilities expected their financial situation to improve (7% for revenue, 4% for expenses) or worsen (8% for revenue, 6% for expenses), and a significant minority expressed uncertainty (16% for revenue, 17% for expenses).

Utilities that expect their financial situation to worsen with respect to operating revenue overwhelmingly identified nonpayment of bills as a contributing factor (82%), compared to 33% and 22% identifying decreased use and reductions in rates/fees respectively as contributing factors.

Utilities that expect their financial situation to worsen with respect to operating expenses identified consumables as the primary contributing factor (74%). Personnel costs were also a leading factor affecting 55% of utilities with a worsening outlook for operating expenses. Personnel costs would include expenses such as overtime or increased hours. More than half (55%) of utilities also identified utilities costs as a contributing factor.

4.4 Mitigating Actions

EPA asked all survey participants (regardless of whether they provided financial data) whether they had taken or were planning to take any mitigating actions in response to experienced or anticipated decreases in cash flow. Figure 4.8

"Overall less revenue is coming in and general expenses, shipping, cost of supplies are increasing"

"[We serve] a vacation community heavily reliant on tourism. [The shutdown] has wreaked havoc on the local economy . . . . It is expected that the full burden will not be felt until 2021."

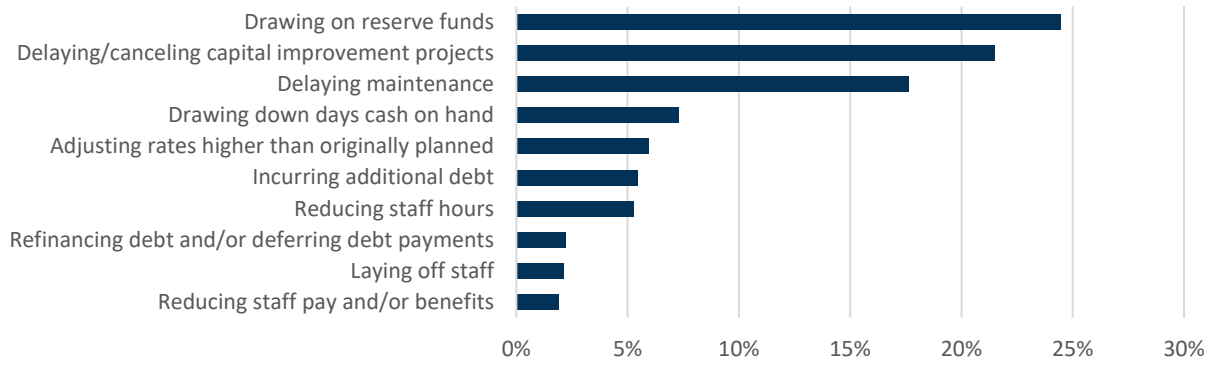
"We are concerned about longer term impacts as the pandemic continues."

"We cut back on asset management due to reduced staffing. It will take longer to perform and the costs of these materials will increase."

"We have relied mainly upon reserves to cover the loss, expecting use has [returned] or will soon return to normal."

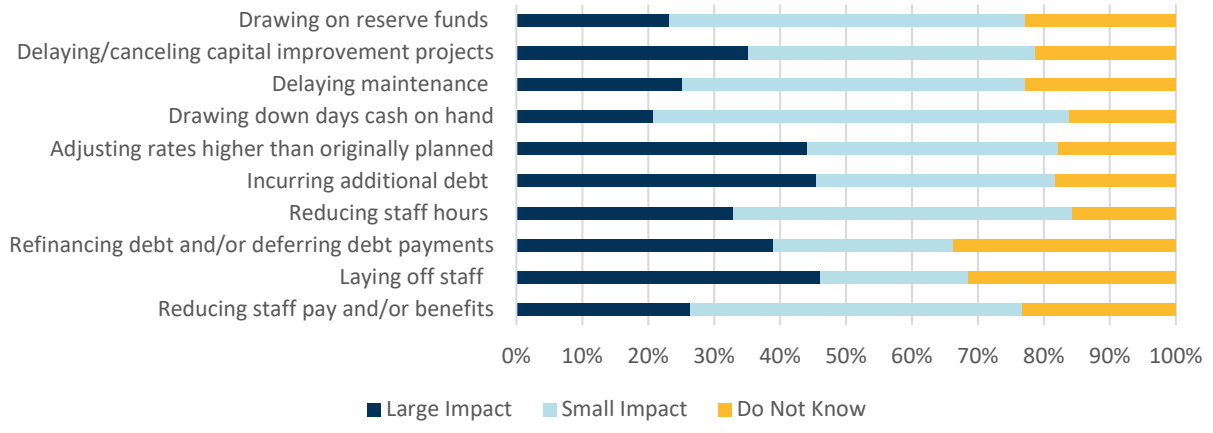
shows what mitigating actions have been taken or planned by the nation's water and wastewater utilities. The three most common mitigating actions were drawing on reserve funds (undertaken or planned by 24% of utilities), delaying or canceling capital improvement projects (22%), and delaying maintenance (18%). Generally, smaller percentages of utilities made or planned personnel or salary changes, such as reducing staff hours (5%), laying off staff (2%), and reducing staff pay and/or benefits (2%). However, reducing staff hours was a common action taken or planned by AI (31%) and ANV (29%) utilities. In addition, 22% of ANV utilities adjusted rates higher than originally planned. Overall, 48% of utilities took one or more action to mitigate the potential decrease in cash flow.

Figure 4.8. Percentage of Utilities That Took/Planned Mitigating Action



For each action utilities reported taking or were planning to take to mitigate the decline in cash flow, information was also provided about the estimated effectiveness of that action. As shown in Figure 4.9, every mitigating action was judged to be at least somewhat effective by a majority of utilities. Those options judged most effective were laying off staff, incurring additional debt, and adjusting rates upward. (The estimated effectiveness of some of the actions in Figure 4.9 is based on a small number of responses, depending on how many utilities selected the actions shown in Figure 4.8. The number of utilities selecting each action ranged from several dozen to several hundred. Exact figures, and the confidence intervals associated with the findings, are presented in Appendices C-G.)

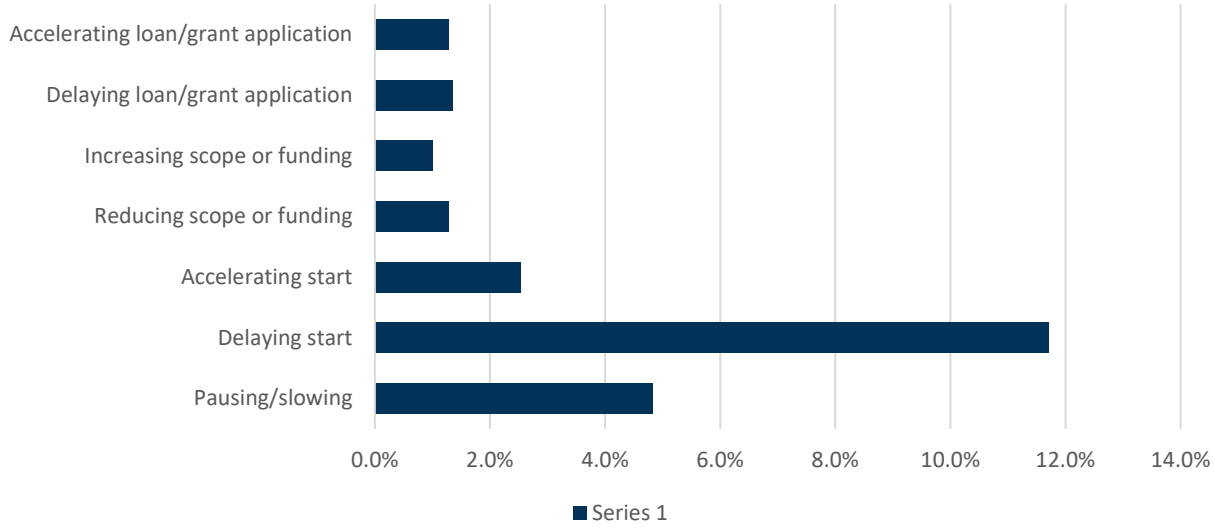
Figure 4.9. Expected Impact of Actions in Mitigating the Decrease in Cash Flow



Most utilities have been unaffected by the pandemic when it comes to capital project planning. But, as shown in Figure 4.10, 12% of the nation's water and wastewater utilities delayed or considered delaying breaking ground on a new project, and another 5% paused or slowed or considered pausing or slowing a project already underway. Another 3% accelerated or considered accelerating a capital project. AI and ANV utilities were more likely than CWSs and WWTPs to report that the pandemic affected capital project planning.

"We still plan for a more substantial revenue loss, so [we] continue with reducing expenses and keeping capital projects on hold."

Figure 4.10. Actions Taken or Considered Re: Capital Infrastructure Projects Due to COVID-19



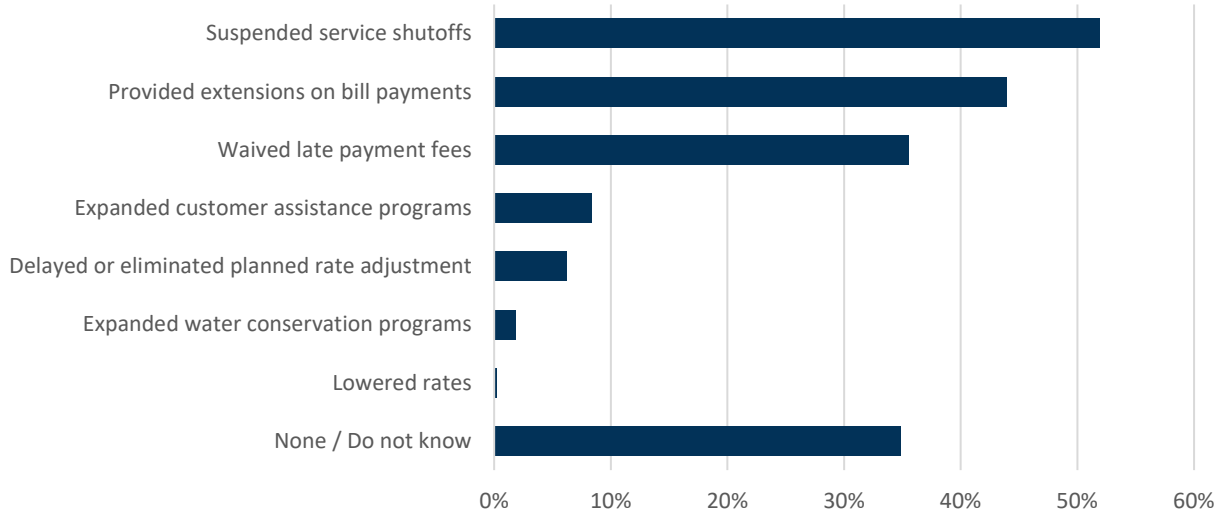
Approximately 65% of utilities took one or more type of action to provide relief to struggling customers. Most notably, as shown in Figure 4.11, 52% suspended service shutoffs, 44% provided extensions on bill payment, and 36% waived late payment fees. Among participants who responded "None" or "Do not know," some noted that they are wholesale systems that sell finished water to other utilities, or that their revenue comes from a municipal budget, or that in some other way the question was not applicable. AI and ANV utilities were more likely than CWSs and WWTFs to provide relief by expanding customer assistance programs and water conservation programs. Especially among CWSs, larger utilities were more likely to take actions of this type than smaller utilities.

"From March to July [2020], we suspended late penalties and shutoffs. We resumed late penalties and shutoffs in August."

"Encouraged customers to contact us to establish payment arrangements if they are unable to pay their bill."

"To address [customer impacts], there will be no rate increases next year."

Figure 4.11. Actions Taken to Alleviate Economic Impacts on Customers During the Pandemic



5.1 Issues Encountered with Sampling

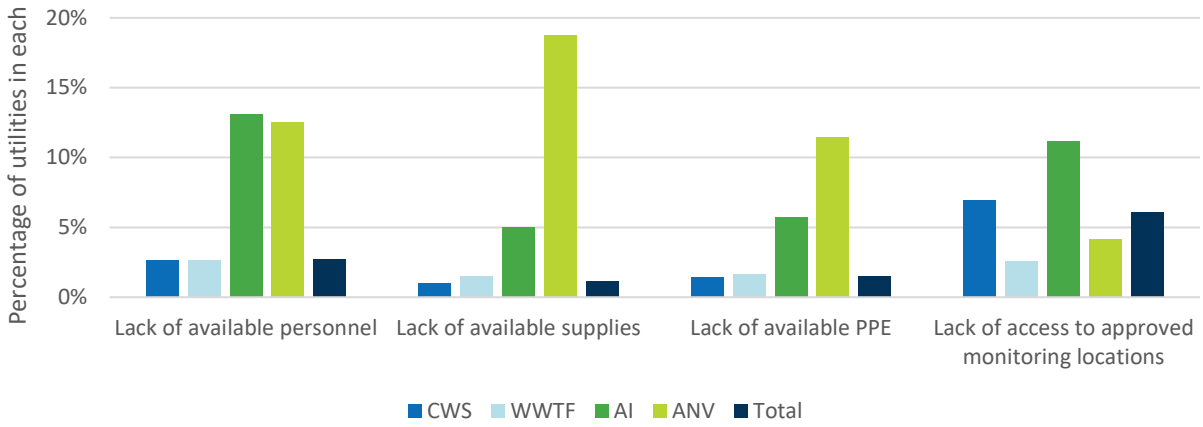
Only about 11% of water and wastewater utilities experienced pandemic-related conditions that interfered with sample collection. The most commonly cited challenge, which affected 6% of utilities, was lack of access to approved monitoring locations, such as drinking water coliform sampling taps in homes and businesses or wastewater pre-treatment sampling locations. Lack of access to approved monitoring locations was mostly reported as a concern by CWSs (especially larger CWSs, defined as those serving over 10,000 customers) and AI utilities. As shown in Figure 5.1 below, lack of available personnel for sample collection was a problem for 13% of AI utilities and 13% of ANV utilities. Lack of available supplies for sampling and/or shipping was a problem for 19% of ANV utilities. Lack of PPE was a problem for 11% of ANV utilities. While lack of PPE for sampling was a problem for only 1% of CWSs overall, it affected 5% of the CWSs serving between 10,000 and 100,000 people and 27% of CWSs serving over 100,000 people.

"We were [already] converting sampling stations from in-home and in-business to outside sampling ports. These made the sampling process much easier in COVID conditions."

"We used approved alternate sites for Total Coliform Rule sampling."

"In order to ensure that essential lab functions were carried out with limited laboratory personnel, we utilized our Continuity of Operations Plan (COOP). . . . The plan allowed us to exclude from sampling, analyzing, and reporting plant raw influent wastewater samples and river samples upstream and downstream of the plant outfall."

Figure 5.1: Pandemic-Related Conditions Interfering with Completion of Required Sampling



5.2 Issues Encountered with Laboratory Analysis

Similarly, only about 12% of utilities experienced pandemic-related conditions that interfered with their ability to complete required laboratory analyses. The most commonly cited challenge, which affected only 5% of utilities overall, was delays in external laboratory service. Additionally, sample transport delays affected around 10% of AI utilities and 34% of ANV utilities. Travel restrictions affected around 18% of AI utilities and 26% of ANV utilities. Note that the confidence intervals around these estimates for Tribal utilities are fairly wide. Confidence intervals are presented in the data tables in Appendices C-G.

"Some labs . . . had staffing issues and were not able to produce results in the typical timeframe. Sometimes this was known and they were able to recommend another laboratory for the month; other times they didn't inform us [and] we missed a reporting deadline."

"Air delivery [from an ANV] will be slowed, which makes it harder to keep the sample from getting old or contaminated while air shipped."

The survey results indicate that few water and wastewater utilities (1% overall) have experienced cybersecurity issues or concerns during the pandemic. The findings differed considerably, however, by utility size. Larger utilities were affected more severely than smaller utilities, regardless of utility type. As shown in Figure 6.1, survey results indicate that cybersecurity issues and concerns affected less than 1% of utilities serving 10,000 persons or fewer, 4% of those serving between 10,000 and 100,000 persons, and 13% of those serving over 100,000 persons.

Types of cybersecurity issues or concerns experienced by water and wastewater utilities during the pandemic have included:

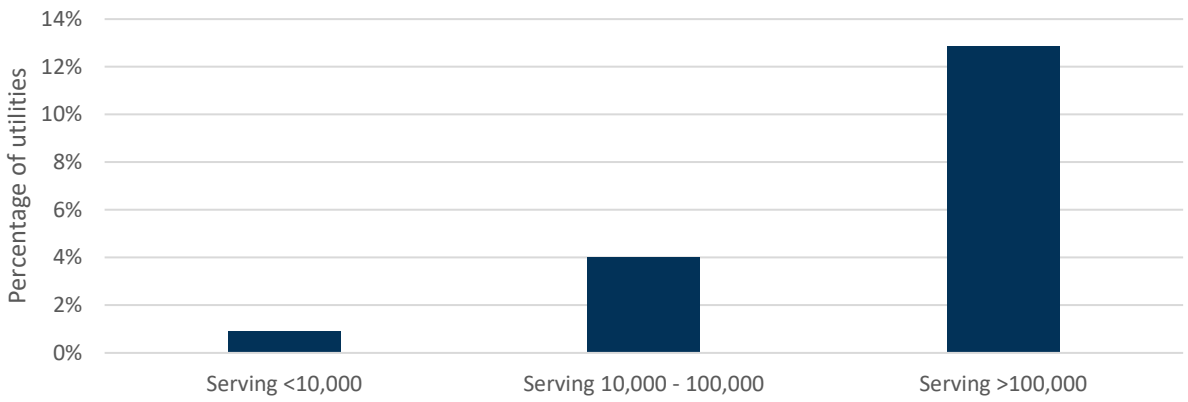
- Email phishing scams
- Ransomware attacks
- Computer viruses and malware
- Hacking of email accounts
- Unauthorized access to bank accounts
- Identity theft
- Fraudulent unemployment claims
- Uninvited attendees at virtual meetings

"There have been increases in phishing and other types of attacks. Our IT has increased training and has also implemented improvements to SCADA and other systems to reduce chances for ransomware attacks."

"Due to COVID-19 and the rise in web based meetings, trainings, conferences, work from home. . . . cyber threats are the new normal."

It is possible that the survey results presented here significantly underestimate the actual extent of cybersecurity issues and concerns at water and wastewater utilities, if (for example) victims of cyberattacks are reluctant to reveal that their systems have been compromised. Other research (e.g., a 2019 State of Cybersecurity Study published by information technology and cybersecurity association ISACA) finds that cybercrime in general may be vastly underreported.

Figure 6.1. Percentage of Water and Wastewater Utilities Concerned about Cybersecurity

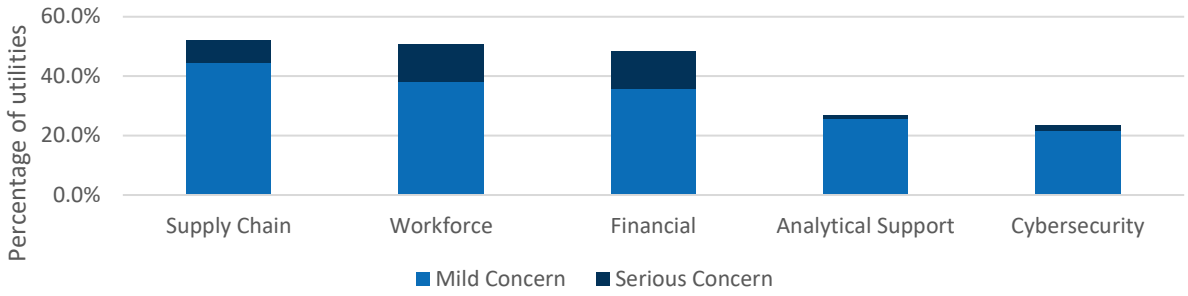


7. OVERALL CONCERNS FOR THE FUTURE

At the end of the survey, participants were asked how concerned they were about the topics covered in the survey in the coming months. The results (see Figure 7.1) show that around half (52%, 51%, and 48%, respectively) of the nation's water and wastewater utilities are at least mildly concerned (expressing either mild concern or serious concern) about pandemic-related supply chain, workforce, and financial impacts in the coming months, and around a quarter (27% and 24%, respectively) have some level of concern about pandemic-related analytical support issues and cybersecurity. AI and ANV utilities have higher levels of concern than CWSs and WWTFs in most categories (relatively low ANV concern about cybersecurity being the main exception). Comparison of results across the five CWS size categories and three WWTF size categories used in the survey shows that larger CWSs and WWTFs generally have higher levels of concern about all topics than smaller CWSs and WWTFs.

On the whole, the responses to this question seem to indicate higher levels of concern than the answers given in the specific sections earlier in the survey (though it is not always possible to compare directly). The more general wording of the question here might account for the difference.

Figure 7.1: Levels of Concern about Topics Covered in the Survey over the Coming Months



A number of survey respondents commented on the high degree of uncertainty about how the pandemic will continue to unfold, and how this made it difficult to answer the survey questions and also plan for the future. Respondents who have experienced no major COVID-19-related issues to date have pointed out that disruption in the supply chain of one chemical, or the illness or quarantining of a small number of key personnel, could have serious consequences for operations.

Uncertainty

"It's a crystal ball problem—continuing as we are will result in mild impacts; things getting worse could result in serious impacts."

"So many unknowns on how our staffing levels may be impacted by illness, family illness, and childcare needs."

"The level of uncertainty and employee stress and wellness is a long-term concern in our ability to maintain operation under this long-term pandemic situation."

"Situation is fluid. Changes daily and we could get set back at any time by having . . . personnel getting sick or quarantined."

While some problems associated with the pandemic, like PPE shortages, have diminished over time, other problems may get worse with time or may only become evident over longer periods. Some survey respondents expressed particular concern about the effects of an extended quarantine on morale and on finances.

Another common theme in the survey responses was the importance of recognizing those in the water sector as essential workers. This lack of recognition is a matter of morale and also a matter of allocation of resources, including vaccines. Many respondents felt that the water sector had not received the support it needed.

Effects of an Extended Quarantine

"At the staff level, COVID fatigue is setting in."

"A prolonged outage due to quarantines would deplete some employees' financial resources and make them want to return to work with an infection rather than miss another paycheck."

"Our utility's ability to pay its bills is directly related to our customers' ability to pay their bills. We all need normal economic activity to resume as soon as possible."

"This is a marathon and not a sprint."

Recognition as Essential Workers

"Water and wastewater are critical to front-line functions such as hospitals and stay-at-home orders. Our workers should always be included in the definition of essential workers."

"Utilities get paid to accomplish the mission, no matter what the circumstances."

"It felt as though we were left to fend for ourselves in many areas"

"We also have concerns over the proposed vaccine distribution schedule not prioritizing water and wastewater operators."